Water Resource Management and Protection Plan

INTRODUCTION

"It cannot be overstated: water is essential to life. Water moves ceaselessly through the natural and manmade environment. The supply and quality of water are directly affected by all that water encounters - the land it flows over and through, pavement and rooftops, through homes and industries. The water cycle is continuous and links all living and inanimate things.

"New England is water rich. The landscape is green. Rain and snow are part of everyday life. But the need for clean water has always been and will be an ever more important limiting factor for the kinds and intensity of development a town, Region, or the landscape can support. New England rivers have rebounded dramatically from the polluted conditions prevalent prior to the 1970's. Scientific and political actions built safeguards against that sort of pollution occurring again in our streams, ponds and groundwater. Today most people have a good understanding about the relationship between use of chemicals and protecting clean water. As our management of threats to water quality become more sophisticated, we are recognizing that water quantity, that is supply of enough water, is fast becoming a management issue as well. We are discovering that even the water-rich northeast has a finite amount of water available each year. About 44 inches of water falls here as rain and snow each year, 40% of which ultimately drains away to the ocean or evaporates back to the atmosphere. We are capable of using our annual water supply faster than it is replaced.

"Historically, the Southwest Region's abundant streams and ponds enabled the development of water-powered industry, the seeds of villages and connecting road networks. River valleys for our larger rivers – the Ashuelot, Connecticut, and Contoocook – provided fertile agricultural land. Rivers and ponds still drive hydroelectric plants, but much of the river valley land now hosts residential and small urban development, and our surface waters are valued mostly as recreation areas and scenery. The vast majority of Southwest Region residents are supplied with drinking water by wells drilled into bedrock. We have distanced our everyday lives from thoughts of water resources: for most of us water comes from the tap not the landscape outside our door." [1]

The purpose of the document is to provide the Planning Board and the Conservation Commission with the best possible tools for managing and protecting water resources for the Town of Mason.

The goals of this document are to:

- Identify and evaluate the adequacy of existing and potential water supply sources to meet the current and future needs of the community:
- Identify existing and potential threats to surface and groundwater resources:
- Evaluate existing local programs, policies, and regulations as they relate to water resources:
- Identify regulatory and non-regulatory programs that would benefit the Town in its water resource management and protection efforts.

[1] Southwest Region Planning Commission. 1998. "Introduction to Southwest Region Towns: Southwest Region Natural Resources"

The variables examined here to support Mason's decisions about water resource management are:

- Hydrography: the characteristics of surface and groundwater, including stream miles, area of surface water, and the nature of geological formations that may contain ground water;

- Land cover and land use: landscape characteristics including area of land covered by natural vegetation and land area altered by development and inventory of land use by type, including potential contamination sources; and

- Future land use: zoning.

Water resource management uses the geography of watersheds as management units - land areas for managing land use and monitoring environmental quality. A watershed is any contiguous land area from which all surface water drains at a single point. Watersheds can be any size, from the Connecticut River watershed which includes most of central New England to a parking lot at a local store. Watersheds are the basic management unit because, simply put, we know where the water that flows through streams, ponds and aquifers within a watershed comes from. Watersheds are delineated or defined by connecting high ground between stream drainage networks. The network formed by rivers, streams, lakes, and ponds is known as the drainage system of the watershed.

Water resource management must account for human effects on the movement and quality of water. Human activity can jeopardize the availability of clean water for human and ecological needs by disrupting the natural processes of water movement. The water cycle is a network of pathways and processes by which water circulates through the environment. **Figure 1** depicts the basic pathways, i.e. precipitation, runoff, infiltration, evaporation, etc that comprise the water cycle. One important aspect of the movement of water is that ground water (water below the water table) tends to flow in the same directions as surface water. The significance of this fact is that idea of using the geography of watersheds to manage surface water is equally useful for ground water.

Altering the terrain and vegetation, dispersing chemicals on purpose or by accident, even drawing water from one place and releasing it elsewhere do effect water quality and quantity locally. The cumulative effect of small changes with each new home and business, each day's car exhaust, and most routine activities do affect water quality and quantity. Increased development has meant an increase in both impervious surface (compacted earth, pavement and rooftops) and site design that drains water away from development into streams. Both divert water from infiltrating into the soil and aquifer, which in turn increases flooding during storms, decreases ground water, decreases stream flow between storms, and can impair water well productivity. Development has also increased the likelihood of the release of pollutants into the soil or onto the surface which are then spread by water. **Figure 2** depicts how urbanization can change percentage of precipitation that runs off to streams and ponds or infiltrates into the ground.

Water resources management strives to minimize disruption of the hydrologic cycle and water quality. Clean water requires clean air and clean soil.

DESCRIPTION AND ANALYSIS OF CONDITIONS AND VARIABLES

WATERSHEDS

While a small portion of Mason (less than 1%) lies within the Souhegan River Watershed, the majority of Mason lies within the Nissitissit River sub-basin of the Nashua River Watershed. The Nashua River Watershed is a sub-watershed of the Merrimack River Watershed and consists of 538 square miles in the Central New England uplands; 31 towns in Massachusetts and New Hampshire with a total population of approximately 423,602 (2000 Census). In New Hampshire, the Nashua River Watershed encompasses almost all of the land area in Mason and Brookline as well as parts of New Ipswich, Greenville, Wilton, Milford, Hollis and Nashua and reaches almost as far south as Worcester, MA.

The unique geography of the Nashua River Watershed has important implications for water quality within its sub-watersheds. The Nashua River flows northward, against the grain of its watershed and in opposition to most of its major tributaries. The highest parts of the watershed are located in the north and west regions; the lowest part is also located in the north where the Nashua River meets the Merrimack River in Nashua, NH. The oppositional flow of the Nashua River to its tributaries means that the Nashua River moves slower than its tributaries. This makes it more vulnerable to oxygen depletion from pollution in comparison to other rivers of similar size. The health of the tributaries within this watershed is therefore very important to the overall health of the Nashua River and the watershed as a whole. Historically, the tributaries of the Nashua River have maintained higher water quality levels compared to the Nashua River; however, increasing population and development threatens the high water quality of the tributaries and the watershed as a whole[2].

Mason is important to the Nissitissit River due to the location of headwater tributary streams being located there, namely the Spaulding Brook system of waterways. The high water quality of the Nissitissit is dependent on the high degree of forestation and little development that characterizes this area. In its current condition the Nissitissit is a cold, clean, well-oxygenated stream that is frequently cited as prime habitat for native brook trout and five listed rare species[3].

Lying at the headwaters of this watershed is a beneficial situation for water resources protection – the vast majority of water running over and through the land of Mason falls on Mason as rain or snow. Most of the streams in Mason begin in Mason. The exception is Walker Brook, which begins in Greenville. This means that Mason has a high degree of control over the aspects of land use management that affect surface water quality in Mason.

The watersheds delineated in this Plan were selected to encompass land areas that are simultaneously 1) of homogeneous development conditions, 2) large enough to support a community water supply, and 3) small enough to support special management programs or activities if desired. Also, watershed areas outside the town boundaries were included only if they are upstream of Mason, i.e., only if the surface and ground water moving through them are known to or potentially may also pass through Mason, thereby directly affecting Mason's water resources. Map __ shows the watersheds delineated in Mason.

[2] 1995 to 2020 Vision for the Nashua River Watershed, prepared by the Nashua River Watershed Association
[3] Nashua River Watershed Five Year Action Plan, 2003-2007, developed by the Nashua River Watershed Association and the Massachusetts Watershed Nashua Team

Watersheds in the Town of Mason			
Watershed	**Watershed Towns**	**Watershed Acres**	**Acres in Mason**
1- Spaulding Brook	Mason, Wilton	4,514	4,115
2- Lancy Brook	Mason, Brookline	1,219	1,119
3- Gould Mill Brook	Mason, Brookline	2,059	1,946
4- Mason Brook	Mason, Townsend (MA)	1,424	1,358
5- Rocky Brook	Mason, Greenville	4,310	3,851
6- Wallace Brook	Mason, Townsend (MA)	564	349
7- Walker Brook	Mason, Greenville, New Ipswich, Ashby (MA)	3,446	1,220

SURFACE WATER RESOURCES

Surface water systems are any type of water resource located above the ground on the earth's surface, such as streams, rivers, ponds, lakes, and wetlands. Surface water is typically a result of ground water breaking out. The elevation of the surface of water in streams, lakes, ponds and wetlands is often the elevation of the groundwater at that point – that is, the ground surface is below the elevation of the water table.

Surface water systems may be more dynamic than groundwater systems, in that they are directly affected by wind, rain, radiation from the sun, daily and seasonal temperature change, and changes on or above the earth's surface created by human activity. Surface water systems can be flowing or standing. Surface water systems are also important plant and animal habitat.

Mason receives about 44 inches of water from snow and rain each year, of which an average of 40%, or 18 inches, is released back into the atmosphere by evapotranspiration- the processes of evaporation and transpiration. Evaporation is the loss of water from open bodies of water. Transpiration is the loss of water from living plant surfaces. Runoff is also a source of surface water loss.

An inventory of surface water resources is shown below. Lakes and ponds, streams, wetlands and floodplain areas are all important resources. Map 1 also shows surface water resources in Mason.

SURFACE WATER RESOURCES INVENTORY

		Nashua River- Squannacook River to Mouth				Squannacook River			Other*
	Total	1 Spaulding	2 Lancy	3 Gould	4 Wallace	5 Mason	6 Rocky	7 Walker	
Total Area in Watershed- (acres)	**18,917**	4,514	1,219	2,059	564	1,424	4,310	3,447	1,380
Total Area in Watershed- In town (acres)	**15,341**	4,115	1,119	1,946	349	1,358	3,852	1,221	1,381
Total Area in Watershed- Out of town (acres)	**3,576**	399	99	113	214	66	458	2,226	0
Lakes and Ponds (Count)	**48**	14	3	5	0	4	13	9	0
Lakes and ponds- Area (acres)	**105**	59	5	5	0	15	9	12	0
Streams (miles)	**66**	6	3	8	0	4	22	20	1
Wetlands (USGS, NWI) (acres)	**876**	234	77	112	41	96	175	102	38
Flood Zone (A) (acres)	**240**	0	32	65	18	59	8	59	0
Developed Area- Impervious Surface (acres)	**993**	192	32	157	1	156	297	113	45.3
Forested (acres)	**17,850**	4,294	1,158	1,902	563	1,259	4,010	3,328	1,343.0
% Forest Cover	**94%**	95%	95%	92%	100%	88%	93%	96%	97%

**Other includes all in town areas not delineated in watersheds*
Note: Forested excludes areas covered by roads, structure impacts, and water bodies
**Other includes all in town areas not delineated in watersheds*
Note: Developed includes road area and structure impact

The watersheds delineated in Mason are mostly forested. Estimated percentages of forest cover range from 88% for the Mason Brook watershed to 100% for the Wallace Brook watershed[4]. Stream densities (miles of stream per acre) are fairly uniform throughout the area.

Surface Water Quality

Each of New Hampshire's lakes, ponds and rivers is assigned a legislative water quality classification as follows:

- Class A – The highest quality and potentially acceptable as public water supply sources after disaffection. No sewage or wastes shall be discharged into these waters.
- Class B – The second highest quality and no objectionable physical characteristics. No sewage or waste shall be discharged in to these waters unless it has been treated. Acceptable for bathing and other recreational purposes and, after adequate treatment, for use as public water sources.
- Class C – Acceptable for boating, fishing, or for industrial water supply. These waters cannot be used as a public water supply source.

Currently, Pratt Pond, the only water body monitored by the NH DES in Mason, is classified as Class B Waters.

The NH Department of Environmental Services has carried out a field research program: "New Hampshire Lakes and Ponds Inventory," since 1976. "The purpose of the survey is to provide information on current baseline conditions, long-term trends, water quality compliance, trophic state, acid

[4] Forested land is all land excluding roads, structures and structure impacts, and waterbodies, as analyzed using GIS.

rain impacts, and exotic weed distribution" in New Hampshire's great ponds (waterbodies ten acres or larger). NH DES accomplishes inventory surveys for 50 or so of the State's 780 great ponds each year. Pratt Pond is the only water body in Mason monitored by the NH DES. The last monitoring took place in summer of 1992 and winter of 1993.

The reports include a bathymetric map for each pond that also shows the general distribution of aquatic plant species, the results of standard chemical and physical water quality tests, and comments about dams, wildlife, or other incidental observations. Water quality information for Pratt Pond is available at http://nhwatersheds.unh.edu/quality.asp?id=691. The full reports for these ponds are available for review from the NH DES Lakes Program.

Today, NH DES conducts a Volunteer Lakes Monitoring Program (VLAP) which provides training, lends equipment, and provides laboratory testing for standard water quality parameters of water samples collected by volunteer groups – often private lake associations or Conservation Commissions. There is currently no individual or organization in Mason that monitors Pratt Pond for the VLAP.

Surface Water Users

Water users who discharge or withdraw more than 20,000 gallons of water per day must register with NH DES and are termed "registered water users." The inventory in Appendix A indicates that Mason Quarry is characterized as inactive for both surface water withdrawal and discharge to Old Quarry Pond.

Wetlands

Wetlands, for regulatory purposes in Mason, are "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." The Town of Mason delineates wetlands "in accordance with NH RSA 482-A and the criteria referenced under Article XVI.B.1 (Town of Mason Planning Ordinance) through site specific delineation conducted by a soil or wetland scientist certified by the State of New Hampshire.[5]"

Wetlands provide value in the hydrologic cycle for water storage, including floodwater, and eliminating sediments from runoff (including pollutants), as well as contributing to biological diversity. Regarding water supply concerns, wetlands tend to be a source of water loss from the watershed through evaporation of standing water and evapotranspiration of water taken up by plants and released into the air as water vapor through normal plant metabolism. Evaportranspiration rates for forested wetlands, especially hemlock, can be very high during the growing season. But the flood mitigation, water quality and biodiversity benefits of wetlands are essential to healthy communities.

Environmental Services of wetlands:
- water storage
- groundwater recharge and discharge
- flood control and river regulation
- water purification
- sediment retention

Products of wetlands:
- water supply- domestic and animals
- agricultural resources
- fisheries
- forage resources

[5] Town of Mason Planning Ordinance, March 2005

Floodplains

Floodplains are unique ecological communities: terrestrial systems adjacent to streams and rivers that develop under the dominating effect of periodic flooding. Some species of plants and animals are found only in floodplain habitats. Floodplains provide flood water storage and elimination of sediments from streams – as flood water moves through forested flat land, the water slows and sediment falls out. Recharge to groundwater may also take place on floodplains.

Because the landscape of floodplains is flat and often with sandy soils, floodplains are often desirable locations for development due to the ease with which building can occur. However, using floodplains for development jeopardizes both the sustainability of that development and the natural hydrology and ecology of the floodplains.

Mason participates in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). The Flood Insurance Rate Map (FIRM) is available for review at the Mason Town Hall. FEMA is in the process of updating FIRMs for all of Hillsborough County. Completion of this project, anticipated in the spring of 2007, will require the Town of Mason to adopt the new maps in order to continue participation in the National Flood Insurance Program.

Surface water resources function as holding areas for floodwaters and seasonal high waters. Surface waters are also usually hydrologically connected with groundwater, most commonly, a discharge from groundwater. Groundwater discharge supplies stream flow between rain storms and snow melt periods and during the dryer summer months. The next section describes groundwater resources.

GROUNDWATER RESOURCES

Groundwater is a concentration of water in soils and rock formations. It is re-supplied through precipitation. Rain water and melting snow infiltrates into the ground. Water that is not taken up by plant roots or trapped as soil moisture will continue downward. As water passes through soil, "normal background" impurities (such as, naturally occurring plant nutrients or microbes) are usually removed through chemical reactions with soil particles and soil microbes. Conversely, if the soil is contaminated with chemicals or high concentrations of pathogens, infiltrating water can be contaminated as well. Infiltrating water eventually accumulates on top of an impervious layer below ground, e.g. clay or bedrock, and fills the spaces between grains of sand, gravel or soil particles above that barrier. The top of this saturated zone is the water table (Figure 1).

Groundwater flows in the same general direction as surface water unless confined by bedrock or clay. Most surface water is the result of groundwater "breaking out" and flowing or accumulating on the surface – where the slope of the water table is intersected by the slope of the land surface. In the bottom of valleys, groundwater from the hillsides accumulates in the valley and the surface of rivers and ponds may literally be the top of the water table. Upland streams will also be fed by groundwater. As mountain streams dry up from the top of the hill down in summer, we can observe the fall of the water table as groundwater drains down hill. However, it is not uncommon in central New England highlands for small depressions in bedrock to create groundwater pools – creating "bodies" of groundwater that are isolated from groundwater at lower elevations. Many of the wetlands in Mason may be a result of just such features.

It is very important that the surface of the earth is not altered to prevent water from infiltrating to groundwater. Paving, buildings, compacted dirt, and any other changes in the surface (including deforestation) that will increase runoff during storms and snow melt also decrease the amount of water that can infiltrate to groundwater. (Figure 2). The U.S. Geologic Survey reports that about 50% of the annual precipitation in central New England infiltrates into the soil, sand, gravel and spaces in bedrock under natural forested conditions.

Aquifers are geologic formations, either bedrock or sand and gravel deposits, which can store and transmit sufficient quantities of groundwater to support private residential or community water wells. Deposits of sand and gravel and bedrock fractures in Southwest New Hampshire are known to have medium to high potential as aquifers. Below is the groundwater inventory for Mason showing acres of stratified drift aquifers in each watershed.

GROUNDWATER RESOURCE INVENTORY

		Nashua River Squannacook River to Mouth				Squannacook River			Other*
	Total	1- Spaulding	2- Lancy	3- Gould	4- Wallace	5- Mason	6- Rocky	7- Walker	
Total Area in Watershed- (acres)	**18,917**	4,514	1,219	2,059	564	1,424	4,310	3,447	1,380
Total Area in Watershed- In town (acres)	**15,341**	4,115	1,119	1,946	349	1,358	3,852	1,221	1,380
Stratified Drift Aquifers (acres)	**2,265**	1,127	169	473	145	5	259	45	41

Other includes all in town areas not delineated in watersheds

Bedrock and Glacial Till Aquifers

Bedrock fractures can be very productive water sources, especially if the fractures are connected to sand and gravel over the bedrock. This allows recharge to occur directly from above. Bedrock fractures are usually adequate for domestic wells and can sometimes support community systems. There is very little known about the location or qualities of bedrock fractures in New Hampshire that might provide water. It is expensive and labor-intensive to study bedrock hydrogeology – typically such research is undertaken only when a developer or community is imminently in need of a new well.

In contrast, the mixture of “dirt” and stones that covers most of the bedrock in central New England’s uplands is a poor aquifer. This mixture is known as glacial till which resulted from the mixing of material picked up by the glaciers as they flowed many miles from the north. As the glaciers melted the mixture was laid down in-place unless carried away by running water. Till is a mix of clay, silt, sand, gravel, and boulders which tends to be very compact due to the variety of soil particle sizes. While till can hold a tremendous amount of water, it is very difficult to extract due to the small, even microscopic spaces between soil particles.

Mason is divided by the Campbell Hill bedrock fault, which runs from Rochester, NH in a southwest direction through Mason into Massachusetts. Bedrock faults are fractures along which there is a displacement parallel to the fracture surface. They can have different characteristics based on the age of the fault and to what degree the fault has been filled or sealed with material. Very old faults can loose transmissivity when filled with debris. Other faults, younger in age, retain transmissivity. Faults provide a direct connection of groundwater moving along the fault line.

Water quality within bedrock faults depends on how weathered the fault is. That is, minerals which dissolve into the water, such as Iron, may contaminant the water. However, as flow rates may be higher in faults, contaminants could move away more quickly. Wells dug into bedrock faults typically are more immune to local pollution because the recharge occurs along the fault line over a longer distance and at a higher flow rate. Without further study, it is uncertain as to the characteristics of the Campbell Hill bedrock fault found in Mason.

Three types of bedrock are found in Mason- igneous, metamorphic, and an undifferentiated mixture of igneous and metamorphic. West of the Campbell Hill bedrock fault, and east of the fault in central Mason, is igneous rock from the Devonian Period (approximately 410-360 million years ago). Further to the west is a band of metamorphic schist, quartite, and minor carbonate rocks from the Silurian period (approximately 430 million years ago). East of the fault there are three other bedrock types: 1) two-mica granite, an igneous rock from the Carboniferous-Permian period (approximately 360-245 million years ago), 2) Gneiss of the Massabesic, an undifferentiated mixture from the Precambrian-Ordovician (approximately >450 years ago), and 3) Impure and calcareous quartzite and slate, a metamorphic rock from the Cambrian-Silurian period (approximately 520-430 million years ago). Map 2 shows bedrock types and fracture and fault locations.

Stratified Drift Aquifers

Sand and gravel deposits, also called stratified drift deposits, are typically layers of gravel, sand, silt and/or clay that were sorted and deposited by running water from the melting glaciers 40,000 years ago. They are found primarily along valley bottoms. Stratified drift can have abundant space between same-sized gravel or sand where water can accumulate and flow freely (much like the space in a jar filled with marbles). The space can be more than 30% of the deposit's total volume. Consequently, stratified deposits of sand and gravel are often very good aquifers.

The U.S. Geologic Survey (USGS) completed descriptive studies of the stratified drift aquifers in the Connecticut and Merrimack River basins in the mid 1990's. Data from those studies are used to depict the extent and some characteristics of the stratified drift aquifers in and around Mason shown in Map 3.

The greatest occurrences of stratified drift aquifers, measured by area, are found in the Spaulding Brook, Gould Mill Brook and Wallace Brook watersheds. However, the characteristics of these formations relevant to water supply vary particularly in regard to three characteristics: material, saturated thickness and transmissivity.

All of the stratified drift deposits in Mason are thought to consist of material ranging from medium-sized sand grains to gravel, possibly with interspersed deposits of fine sand. There is a small inclusion of till on the Spaulding Brook-Rocky Brook watersheds boundary. Till is an unsorted mixture of clay, silt, sand, gravel and rock fragments deposited directly by glacial ice. The Spaulding Brook watershed is bisected by the Campbell Hill bedrock fault. The Gould Mill Brook aquifer, largely in the eastern part of the town of Mason and partly in Brookline is composed of sand, gravel, and glacial lake bottom deposits (silt and clay). This aquifer has been measured to be as much as 70 ft thick[6]. The Wallace Brook watershed contains an aquifer composed of stratified drift deposits and an of glacial lake bottom deposits.

The saturated thickness of a stratified drift deposit is the vertical distance from the water table in the aquifer to the bottom of the aquifer, typically bedrock. The saturated thickness of the deposits in Mason, measured in 10-foot intervals, range from less than 40 feet to 40 feet. Most of the deposits are less than 40 feet. The greatest saturated thickness is found in the Gould Mill Brook watershed. Test drilling of a well revealed 40 feet of saturated sand.

Transmissivity is a measure of the rate at which water can move through the material, using a usual unit of measure: "feet squared per day". Transmissivity takes into account the size of the spaces between sand grains or gravel and the saturated thickness. Transmissivity is reported by the USGS in 1,000 ft^2/d

[6] Geohydrology and Water Quality of Stratified-Drift Aquifers in the Middle Merrimack River Basin, South-Central New Hampshire. USGS Water Resources Investigations Report 92-4192. Bow, New Hampshire: 1995.

intervals. Transmissivity of less than 1,000 are generally considered inconsequential for large water supply wells, but, are excellent aquifers for individual wells serving homes or businesses. Transmissivity of aquifers in Mason range from 0 to 2,000. Again, the Gould Mill Brook watershed has the greatest potential for high yield wells due to high saturated thickness and high transmissivity (greater than 1,000 ft^2/d).

Wells

All water supplies, private and public, in Mason are groundwater wells. A public water supply is any source that provides water to 15 permanent connections or 25 people 60 or more days a year. Public water supplies are regulated by the State, as required by the US EPA. Public water supplies are further delineated into community systems that serve residential uses, transient systems that serve different people everyday and non-transient, non-community sources that serve the same people everyday but not in a residential setting. This definition captures municipal and private wells, such as schools, campgrounds, restaurants, large employers, and village systems.

WELLS

		Nashua River Squannacook River to Mouth				Squannacook River			Other*
	Total	1- Spaulding	2- Lancy	3- Gould	4- Wallace	5- Mason	6- Rocky	7- Walker	
Private Wells (count)	**108**	28	6	19	0	13	16	17	8
Private Wells (In town)	**76**	16	6	13	0	13	14	6	8
Public Wells (count)	**16**	1	0	2	0	0	2	9	2
Public Wells (In town)	**7**	0	0	2	0	0	2	1	2
Wellhead Protection Area-total (acres)	**2,956**	0	0	0	0	0	379	2,578	0

There are four public water supply sources within the Town of Mason; two are non-transient, non-community systems located at the Mason Public School and Imagine That Learning Center, while the other two are transient systems, Pickity Place and Parker's Maple Barn. Also, since 1984, water well drillers are required to report the location and basic information (depth to water table, pump test results, etc.) for new or re-drilled wells of any kind in New Hampshire (Map 3). While there remain hundreds of private residential and commercial wells in Mason that are not identified in any data base, it is safe to assume that every house, apartment building and business has a water well.

Another level of regulation is involved when water withdrawals by a single user exceed 20,000 gallons per day. Such users are required to be registered with the NH DES Water Supply Engineering Bureau. There are no active registered users in Mason that exceed 20,000 gallons per day, however Mason Quarry on Starch Mill Road is an inactive water return *and* withdrawal registered user.

Pumping water from wells can change the direction of groundwater flow in the vicinity of the well. Three variables affect the magnitude of this effect: the gradient of the water table, the transmissivity of the aquifer and the pumping rate of the well. In general, the lower the gradient, or flatter and slower moving, the water in the aquifer; the higher the transmissivity of the aquifer; and the higher the pumping rate of the well; the greater the area influenced by well pumping. This area is known as the Zone of Contribution, or the Wellhead Protection Area (WHPA).

The shape of WHPA's in stratified drift aquifers varies a great deal, but generally extends farther from the well uphill or upstream from the well. The WHPA for bedrock wells is often simply assumed to be circular with the well at the center; the size of the circle determined by the pumping rate of the well.

There are two WHPA's for bedrock wells in Mason recognized by NH DES. They are centered on the well located at the Mason Public School, and around the well located at Imagine That Learning Center. Even though the wells are not in Mason, those in the Greenville Estates in Greenville have wellhead protection areas that extend across the town boundary into Mason. These wellhead protection areas constitute a large portion of the Walker Brook watershed. Map 3 includes WHPA's calculated or estimated by NH DES for the public water supplies in Mason.

Understanding the size and shape of WHPA's is important because these are areas where public health is most directly threatened by pollution of the soil or groundwater. Groundwater use, regulation of potential pollutants, and design of septic systems are in part based on assumptions about the fate of potential pollutants (chemical or biological) once released onto or into the air, soil or water. Much of the conventional risk management is based on pollutants being diluted in water or otherwise attenuated by adhesion to soil particles or biodegradation. These assumptions may not apply to WHPA since the groundwater moves very quickly to the well therein. Any substances released into the soil or water within WHPA's can move directly to the well undiluted or otherwise attenuated.

Groundwater Users

Water users who discharge or withdraw more than 20,000 gallons of water per day must register with NH DES and are termed "registered water users." The Inventory in APPENDIX A indicates that Greenville Estates, in the Walker Brook watershed is an active water user as a water supplier. Greenville Estates withdrawals water from a bedrock well field.

POTENTIAL THREATS TO WATER RESOURCES

Point and Non-Point Pollution Sources

As surface water systems flow over the land, they are subject to pollution caused either by hazardous materials located in close proximity to the system, or by pollutants discharged into the water. There are two types of pollution source categories; non-point sources and point sources. Non-point pollution sources are small dispersed sources that collectively release contaminants over large areas, such as exhaust from automobiles and lawn mowers; pesticides spread on lawns and farm fields; junkyards; and oil, other chemicals and metal particles left on pavement by motor vehicles. Point sources are contaminants or discharges which are transported by confined or discrete conveyance structures such as pipes, ditches, channels, wells, etc.

Appendix A contains an inventory of potential pollution sites.

CLIMATE CHANGE AND WATER RESOURCES- New Hampshire Local Impact Assessment Project (LIAP)

The purpose of the New Hampshire Climate Change Local Impact Assessment Project was to bring greater understanding of the complex issue of climate change and its potential impacts to NH stakeholders. Participating scientists identified the following water resource issues as having likely impacts in New Hampshire from Climate Change:

High Consensus

- Flooding
- Snow depth/pack/duration

- Erosion, sedimentation, pollution loads
- Harmful algal blooms in freshwater systems
- Coldwater fisheries
- Warm water fisheries
- Shellfish resources
- Drinking water supplies
- Saltwater incursions
- Waterborne diseases
- Surface water quality
- Non-native species

Moderate Consensus
- Droughts
- Algal productivity

Low Consensus
- Wetlands

Consensus papers on each issue identifying the likelihood, supporting research, and expected direction of potential changes are provided in an appendix of the report.

DESCRIPTIONS OF THE COMMUNITY'S INFRASTRUCTURE

Septic Systems

Since there is no public sewer system in Mason, all housing units are served by septic systems. According to NH Office of Energy and Planning, there were 535 housing units in Mason in 2005 which translates to approximately the same number of septic systems (535).

Solid Waste Facilities

The Town of Mason operates a Transfer - Recycling Center on the 13 acre site of the old town dump and landfill, located at 60 Quarry Road. As of September 1, 1990, recycling has been mandatory in Mason. The Mason Landfill, which closed in 2000, was the former site of a waste facility for Mason Mills, Inc., and is currently classified by NH DES and U.S. EPA as a Resource Conservation and Recovery Act "RCRA" Brownfield hazardous waste site. This classification means that NH DES and/or U.S. EPA oversee the generation, transportation, treatment, storage, and disposal of hazardous waste. See Appendix A.

WATERSHED LAND USE

Watersheds were assessed for the number of properties as a measure of the number of individual land owners which in turn may represent the complexity of management programs. The size of properties was also queried to determine the imminence of development or opportunity for land protection or the effectiveness of new protective zoning standards on future development. Rocky Brook and Spaulding Brook have by far the highest count of properties but they also have the largest land areas. To get a better sense of the density of development in each watershed it is necessary to look at the lot to acreage ratio. This calculation shows that higher levels of development occurred in the Mason Brook Watershed and the Walker Brook Watershed. Spaulding Brook Watershed does have areas of dense development although the denser development is predominantly located away from the majority of streams and ponds in the watershed. Rocky Brook Watershed has areas of dense development, much of it located along Rocky Brook.

Commercial and industrial development accounts for very little land area in Mason. Most commercial land uses occur mainly as home-based businesses throughout the community. There are 32 properties that have commercial/residential uses and 15 properties with commercial only uses. Most of the commercial uses are located in the Walker Brook watershed (8), with the remainder located in the Rocky Brook (3), Spaulding (2), Wallace (1), and Mason Brook (1) watersheds. Map 4 shows land uses by watershed.

Individual septic systems are of concern regarding surface water and groundwater protection. Failing or substandard systems can release pathogens, nutrients and chemicals from households to groundwater and surface water. Areas with higher density and older housing are especially susceptible to septic system failures due to aged or under-designed systems. Review of land use densities combined with local knowledge of the age and history of neighborhoods can provide Town officials with good indication of the level of threat throughout town. Land along main roadways may be most vulnerable to system failure or cumulative effects of decades of high density on-site septic disposal.

NH DES has prepared "Assessments of Public Water Supply Sources" for many supplies in New Hampshire, including 4 in Mason (Appendix B). These reports rank the level of risk imposed by fifteen variables, such as proximity of the well and the WHPA to septic systems, development and known potential contamination sources. Overall, the level of risk to the wells investigated by NH DES to-date in Mason is low. Further information can be had from the NH DES Water Supply Engineering Bureau or on the NH DES website. Reports for Mason water supplies are available for review at the Town Offices.

NH DES Water Supply Engineering Bureau prepared a report entitled "Inventory of Public Water Supply Sources and Potential and Existing Sources of Groundwater Contamination in Mason, NH" which provides information about water supply and contamination sources in Mason. A corresponding map, Map 5 reflects the inventory information.

ASSESSMENT OF GROWTH IN DEMAND FOR WATER

Regarding water consumption in Mason, estimates can be applied to better understand the amount of water used in Mason. As stated above, water used in Mason is processed through homes, gardens and businesses and returned to the ground or surface waters nearby. USGS recommends an estimate of 65 gallons per day per person in New England. The principal variable in rates of water use appears to be household income. Northeast Rural Water Association provides the following use rates:

National Average for Residences		170 gallons per connection
National Average for Businesses		250 gallons per connection
Central New England Residences		
	Low-Moderate Income	55 gallons per day per person
	Middle Income	65 gallons per day per person
	High Income	500 (up to 1,000) gallons per day per person

A very rough estimate of residential water demand can be calculated using information about household size and income from the 2000 U.S. Census. The 2000 population of Mason was 1,147 living in 433 households. The average household size was 2.65 persons. If income groups of less than $35,000 for low-moderate income households, $35,000 - $150,000 for medium income and greater than $150,000 for high income are used, the first step is to multiply the number of households reported in these income intervals by the Census by the average household size of 2.65; the second step is to multiply the number of people in the household income intervals by the water use rates provided by Northeast Rural Water; fourth, add the daily water use estimates for the three income intervals; and last multiply that daily total by 365 days. The resulting estimates for residential water demand in Mason are 109,486 gallons per day. Each year, 39,962,390 gallons of water are drawn from wells, processed through the daily routine of Mason residents and returned to the ground through septic systems or other waste water treatment.

In 1999, the American Water Works Association published the following national average water consumption rates in gallons per person per day by type of indoor domestic use. The average per person daily water consumption was 69.3 gallons. Two years prior, in 1997, the Association estimated the average per person daily water consumption was 48 gallons.

1999 Average Per Person Daily Water Consumption

USE	**National Average** (gal / person / day)	**Percent of Total**
Showers	11.6	16.8
Baths	1.2	1.7
Clothes Washers	15	21.7
Dishwashers	1	1.4
Toilets	18.5	26.7
Leaks	9.5	13.7
Faucets	10.9	15.7
Other	1.6	2.2
TOTAL	**69.3**	**100%**

NH Office of Energy and Planning produces population estimates and projections and household and housing unit estimates for all towns in New Hampshire. As shown below, the population of Mason is projected to increase steadily over the next 25 years, increasing also the population density. As population increase, water usage increases.

	2000 (Census)	**2005** (OEP Estimate)	**2025** (OEP Projection)
Population	1,147	1,307	1,540
Households	433	500	n/a
Household Size	2.65	2.61	n/a
Population Density (ppl/sq mi)	48	55	64
Housing Units	455	535	n/a

With an increase in population, water conservation should be considered to minimize the impact of the additional water demand on Mason's water resources. Updating outdated toilets, for example, can save substantial amounts of water: most toilets installed before 1980 use 5-7 gallons of water per flush. Toilets installed between 1980 and 1993 use 3.5 gallons per flush. Toilets installed since 1994 use 1.6 gallons.

DESCRIPTION OF EXISTING PROGRAMS AND POLICIES

Watershed Zoning

There are three zoning districts in Mason: 1) Village Residential (VR) District, 2) General Residential, Agricultural, and Forestry (GRAF) District, and 3) Historic Preservation (HP) District. Most of Mason (91%) is zoned GRAF. 8.3% of Mason is zoned VR and a small portion, 1%, of Mason is zoned HP. GRAF District lots must be a minimum of 3.03 acres with 250 feet of frontage, whild VR and HP Districts must be a minimum of 2.02 acres with 200 feet of frontage. Approximately 982 acres of Mason is protected land. This land ranges from parcels with conservation easements (on which no development is allowed) to deed restrictions (some restrictions on the land) to Town-owned land.

Mason has no commercial or industrial zoning, therefore all commercial or industrial uses must be approved on a case-by-case basis.

Mason is expected to continue to experience steady residential development, with a high demand for low density, detached single-family housing within commuting distance to Nashua, Manchester and cities in Massachusetts. Population projections anticipate an 18% increase in residents from 1,307 in 2005 to about 1,540 in 2025 – which could translate to as many as 90 new homes if the household size remains constant. Lower density development can be less detrimental to water quality and quantity and support on-site water supply and waste water treatment, but the cumulative effects of impervious surface and the purposeful or accidental release of pollutants in suburban areas can be every bit as damaging to water quality and supply as urban development.

Zoning and subdivision/site plan regulations are important aspects of water resource management. Mason has land use standards found in several zoning provisions and subdivision and site plan review regulations, which specifically or indirectly protect water resources as follow:

Wetland Conservation District Ordinance *(Overlay District)*
(Adopted March 11, 1986; Amended March 12, 2000)

- The Wetlands Conservation District is determined to be all surface waters and wetlands. "Wetlands" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal conditions does support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

- Delineation of wetlands shall be in accordance with NH RSA 482-A and the criteria established and defined by the Corps of Engineers Wetlands Delineation Manual, 1987 through site specific delineation conducted by a soil or wetland scientist certified by the State of NH. A certified soil or wetlands scientist determination is not required for minimum impact projects unless they are part of a subdivision.
- Septic System Setback: No septic tank or leach field may be constructed or enlarged closer than 75 feet to any wetland
- Permitted Uses: Any use that does not result in the erection of any structure or alter the surface configuration by the addition of fill or by dredging and that which is otherwise permitted by the Ordinance. Uses include Forestry, cultivation and harvesting of crops, water wells, maintenance of existing drainage ways, wildlife habitat management, recreational uses, conservation areas, open space.
- An application must be made to the Zoning Board of Adjustment for a special exception for any change in the use of wetlands.

Floodplain Development Ordinance *(Overlay District)*
(Adopted June 9, 1998, amended (TOWN MEETING 2007))

- Mason has adopted the *New Hampshire Model Floodplain Development Ordinance for Communities with Special Flood Hazard Area (SPFA)*.
- Regulations apply to all lands designated as special flood hazard areas by the Federal Emergency Management Agency (FEMA) in its FIA Flood Hazard Boundary Maps (FHBM) of Mason dated Feb 21, 1975, as reissued on Dec 1, 1992, and any revisions thereafter.
- The Building Inspector shall review all building permit applications for new construction or substantial improvements to determine whether proposed building sites will be reasonably safe from flooding.
- Where new or replacement water and sewer systems area proposed in an SPFA the applicant shall provide the Building Inspector with assurance that these systems will be designed to minimize or eliminate infiltration of flood waters into the systems and discharges from the systems into flood waters, and on-site waste disposal systems will be located to avoid impairment to them or contamination from them during periods of flooding.
- An applicant shall notify the NH DES Wetlands Bureau and the Building Inspector prior to alteration or relocation of a watercourse. All development in Zone A shall meet the following requirements: No encroachments, including fill, new construction, substantial improvements, and other development are allowed within the floodway that would result in any increase in flood levels within the community during the base flood discharge.
- Variances and Appeals: Any order, requirement, decision, or determination of the Building Inspector made under this ordinance may be appealed to the ZBA as set forth in RSA 676:5. If the applicant, upon appeal, requests a variance as authorized by RSA 674:33, I(b), the applicant shall have the burden of showing in addition to the usual variance standards under state law: A.) that the variance will not result in increased flood heights, additional threats to public safety, or extraordinary public expense; B.) that the requested variance is for activity within a designated regulatory floodway, no increase in flood levels during the base flood discharge will result; and C.) that the variance is the minimum necessary, considering the flood hazard, to afford relief.

The Planning (Zoning) Ordinance of 1967 (incorporating amendments through March 2005)

Article IV: General Provisions

G- No privy, septic tank, or any portion of a sewage disposal area shall be constructed or maintained less than 75 feet from the edge of a public water body, from a well…

H- No waste waters or sewage shall be permitted to run free into a public water body or be discharged in any way that may be offensive or detrimental to the health of others.

I- All buildings and sanitary systems shall be constructed and maintained in accordance with the standards set and enforced by the NH State Dept of Health and by the NH Water Pollution Commission.

J- A private well or other private water system shall be constructed and maintained in accordance with the requirements of the Public Health Service Drinking Water Standards.

Subdivision Regulations
October 19, 1974, incorporating amendments through April 26, 2006, repaginated June 2006

Section 5- Subdivision Design and Standards
5.02- Character of Land for Subdivision: Land of such character that it cannot, in the judgment of the Board, be safely used for building development purposes because of exceptional danger to health or peril from fire, flood, poor drainage, excessive slope, or other hazardous conditions, shall not be platted for residential, commercial or industrial subdivision, nor for such other uses as may increase danger to life or property, or aggravate the flood hazard. Land with inadequate characteristics or capacity for sanitary sewage disposal shall not be subdivided for residential, commercial or industrial subdivision purposes unless connected to a municipal sewage system.

5.05- Preservation of Existing Features: The subdivider shall give due regard to the preservation and protection of existing features, trees, scenic points, brooks, streams, rock outcroppings, water bodies, other natural resources, and historic landmarks

5.07, C:6 – The bottom of the proposed leaching bed or trench and the flood of a leaching cesspool or leaching pit shall be a minimum of four feet above any seasonal high water table.

5.07, D:5. The designated leach field area for the proposed subdivision shall be set back as required in sub-section 6 (below) from:
a. poorly and very poorly drained soils.
b. naturally deposited soils which have a seasonal high water table less than six (6) inches from the surface.
c. naturally deposited soils which have an impermeable layer closer than two (2) feet to the surface.
d. naturally deposited soils which have bedrock less than three (3) feet below the surface.
e. drainageways, natural or man made, perennial or intermittent.
f. open drainage structures intended to convey water, intermittently or perennially, including but not limited to roadside ditches, culvert openings, diversions, and swales.
g. existing leach fields.

5.07, D:6. The designated leach field area is required to be set back from all of the areas specified in sub-section 5 (above) as follows:
a. Seventy five (75) feet if the designated leach field area is entirely located in well-drained soil without a restrictive layer, or well-drained soil with a restrictive layer and slopes of less than eight percent (8%).
b. One hundred (100) feet if the designated leach field area is entirely or partially located in somewhat poorly drained or moderately well drained soil, or well drained soils with a restrictive layer and slope of eight percent or greater (>8%).

c. One hundred twenty five (125) feet if the designated leach field area is entirely or partially located in excessively drained soils.

5.07, D:7. In addition, the designated leach field area shall be set back one hundred (100) feet from open water bodies and perennial streams and shall meet all State requirements for setbacks from existing or proposed wells.

5.07, D:8. In areas where the HIS survey indicates bedrock at less than three feet from the surface, sufficient test pits shall be made to ensure that the setback requirements in sub-sections 5 and 6 can be met.

5.07, D:9. The designated leach field area shall not be placed on areas with finished slopes of over twenty-five percent (25%).

5.07, D:10. If the designated leach field area is located on an area with finished slopes from fifteen to twenty-five percent (15-25%), the septic system shall be designed by a registered Professional Engineer.

5.07, D:11. The Plat shall show an existing well or other water supply, or a proposed well site if no water supply exists. The proposed water supply shall be set back a minimum of seventy-five (75) feet from the property boundary, thus preserving the state-required seventy-five (75) feet protection radius.

5.19, B:4. Erosion and Sediment Control: Standards. During construction, the disturbed area shall not be closer than 25 feet to wetland area boundaries.

5.19, C:2. Erosion and Sediment Control: Activities requiring a certified Erosion and Sediment Control Plan. An erosion and sediment control plan shall be provided for all subdivisions, except those defined as "minor subdivisions" per RSA 676:4, III.

5.21. Other Open Space. If no such open space, park or playground is shown on the Town of Mason Master Plan within the boundaries of a proposed subdivision, the Board may, where it deems essential, require that the Plat show one or more sites of character, size, shape and location suitable to be used as community open space or park, in area not to exceed fifteen percent (15%) of the total area of the subdivision. The subdivider may of his own volition exceed the above area requirements. In the case of cluster subdivision or planned unit development, open space shall be not less in area than as provided in the zoning regulations.

GOALS AND RECOMMENDATIONS

The recommendations below are meant to support the following goals for this plan:

Goal 1: Preserve or enhance the quality of water resources within the Town of Mason to ensure the provision of the social and ecological values they support.

Goal 2: Ensure a safe and sufficient supply of water to support existing and future development within the Town of Mason.

Recommendations

1. In general, local officials are strongly encouraged to become familiar with the protection measures described in relevant NH DES *Environmental Fact Sheets* :

A link to Drinking Water Source Protection Program Fact Sheets can be found at http://www.des.state.nh.us/factsheets/ws/ws-12-1.htm.

2. The Town of Mason should enact the New Hampshire Groundwater Protection Program to achieve a management program through reclassification of Mason's wellhead protection areas and other groundwater resources.

New Hampshire Groundwater Protection Act (RSA 485-C), passed in 1991, enables local entities (water supplies, local boards) to implement a groundwater protection program for wellhead protection areas or other groundwater resources. Initially, all groundwater was classified as GB or GA2. Under the act, wellhead protection areas or other valuable groundwater may be reclassified as GAA or GA1. The town is granted authority to enter properties in a designated area to inspect and enforce the implementation of Best Management Practices for the use, storage or handling of potential contaminants sources (PCSs). The classes of groundwater are as follows:

Class	Local Inspection Of PCSs	Description/Comments
GAA	Yes	- Most protected class - Includes groundwater flowing to public water supply wells (wellhead protection areas). - Prohibits six high risk land uses
GA1	Yes	- Local entities identify valuable groundwater resources they want to protect via management of potential contamination sources.
GA2	No	- Includes high-yield stratified drift aquifers mapped by the USGS that are potentially valuable sources of drinking water.
GB	No	- Includes all groundwater not in a higher classification. As in all classes, groundwater must meet drinking water quality standards.

<u>To obtain a GAA or GA1 classification, the local entity or the state must:</u>

1. Identify the area to be reclassified.

2. Inventory activities that could threaten groundwater within the area(s) to be reclassified. (A list of the potential contamination sources to be included in the inventory is found in RSA 485-C:7.)
3. Hold an informational meeting (optional) to inform the public of the intention of implementing a protection program
4. Formulate a management plan that includes:
    a. Notification to potential contamination sources;
    b. Performance of periodic inspections to ensure compliance with best management practices.
5. Submit an application for reclassification to DES. DES will notify all landowners of the reclassification request and hold a public hearing to solicit comments.
6. Maintain the management program. If active management is not occurring, DES may downgrade a GAA or GA1 classification to GB or GA2. Active management includes the following:
    a. Every three years the local entity must update the potential contamination source inventory, notify source owners, and conduct source inspections.

<u>Reclassification of Wellhead Protection Areas to GAA Results In …</u>

- Active management of potential contamination sources to ensure compliance with best management practices as described in Env-Ws 421.
- Prohibition of a few new uses that pose a high pollution risk to groundwater, i.e., landfills, hazardous waste disposal facilities, etc.
- Release detection permits for existing high-risk facilities that would be prohibited, and for new solid waste composting or resource recovery facilities.
- Investigation, inspection, and cease and desist authority to local entity who obtains reclassification.
- Prior notice to municipalities on state environmental permits.
- Technical and enforcement support provided by the state to the local entity who obtains reclassification.

<u>Reclassification of Valuable Groundwater to GA1 Result In …</u>

- Active management of potential contamination sources to ensure compliance with Best Management Practices.
- No prohibitions of land uses.
- Investigation, inspection, and cease and desist authority to the local entity who obtains reclassification.
- Prior notice to municipalities on state environmental permits.
- Technical and enforcement support provided by the state to the local entity who obtains reclassification.

For more information refer to the NH DES *Environmental Fact Sheets* :

- “Local Reclassification of Groundwater to Implement Protection Programs: A Ten Step Process”, WD-WSEB-22-2;
- “Groundwater Reclassification and How it Affects the Property Owner”, WD-WSEB-22-3;
- “Delineating Wellhead Protection Areas”, WD-WSEB-12-2; and
- “Performing an Inventory for Drinking Water Protection”, WD-WSEB-12-3.

An additional document, "Protecting Groundwater Resources" is found in Appendix C.

3. The Town of Mason should consider the establishment of a Health Ordinance pursuant to the guidance document "Model Health Ordinances to Implement a Wellhead of Groundwater Protection Program" published by the NH DES.

A possible alternative to the Groundwater Reclassification program described in (2) is the use of a Health Ordinance for the enforcement of the same standards for Best Management Practices. The Health Ordinance alone might not institutionalize public education and routine inspection as the Groundwater Reclassification program would. However, the Health Ordinance would enable to Town to collect fees and fines to offset the cost of enforcement.

4. The Town of Mason should establish and maintain the paid position of Health Officer in Mason town government.

The maintenance of a Health Officer can provide dedicated municipal attention to a variety of issues, including water quality monitoring and protection. The Health Officers duties could include:

- Primary agent for carrying out Groundwater Reclassification and implementation of the resulting Management Plan;
- Maintain a data base of water use and existing or potential contamination sources;
- Design and implement a voluntary Septic System Monitoring program;
- Design and implement public education activities regarding water resource protection, including water conservation measures;
- Design and implement a volunteer water quality monitoring for streams and waterbodies in Rindge in conjunction with Franklin Pierce College; and
- Respond to complaints of water quality threats, such as substandard septic systems or misuse of potential contaminants.

5. The Town of Mason should develop a town-wide Open Space Protection Plan.

This chapter of the Town's Master Plan identifies areas of Town, types of landscape conditions, or specific properties that are important for a variety of ecological and social values – including plant and animal habitat, scenic views, recreation, and water resource protection. An up-to-date Open Space Plan is the foundation for regulatory measures, municipal land acquisition and any other public policy issues involving conservation. This is lately becoming a standard element of modern Master Plans and would be a fitting companion to the Water Resources Management and Protection Plan.

6. The Town of Mason should pursue Source Water Protection measures, those which protect groundwater and public drinking water, in addition to the Groundwater Protection Program, particularly land conservation, for high yield stratified drift aquifers in the Spaulding Brook and Gould Mill Brook watersheds, and along NH 123 in the Rocky Brook watershed.

Source water protection can be accomplished through restrictive zoning (through a groundwater protection ordinance), land conservation through easement, land acquisition by the Town, a municipal management program such as affected by Groundwater Reclassification, or public education. Areas for protection include the Wellhead Protection Areas for existing public water supplies as well as watershed and aquifer areas deemed suitable for future public water supplies. The Spaulding Brook and Gould Mill

Brook stratified drift aquifers may hold the most promise due to low density development, large watershed areas, and high yield stratified drift deposits. Further development municipal support for source water protection and definition of areas for action would benefit from the process of developing a municipal Open Space Plan.

Matching funds for purchase of easements or land for source water protection are available on a competitive basis through New Hampshire's land and Community Heritage Program (LCHIP) and NH DES Source Water Protection program. Model easements developed by the Society for the Protection of New Hampshire Forests are available through NH DES. Assistance with land conservation is available locally through the Monadnock Conservancy.

For more information refer to the NH DES *Environmental Fact Sheets* :

- "Proposing to Create a New Public Water System", WD-WSEB-6-6 and
- " Protection Programs Required for New Production Wells", WD-WSEB-12-5

7. The Town of Mason should investigate the use of Conservation Subdivision practices to protect water resources.

Conservation Subdivision, a.k.a. Conservation Zoning, like Cluster Development, sets aside part(s) of the property being subdivided for permanent protection from development. The uses of the set-aside may vary according to municipal policy. Unlike clustering, this practice is based in a town-wide plan for identifying the land to be set aside. The municipal Open Space Plan should be the basis for establishing standards or criteria for designating the conservation set-aside – a benefit over the case-by-case negotiation typical of implementation of Cluster Subdivision.

The article "Growing Greener: Conservation Subdivision Design" by Randall Arendt which was published in the Winter 1999 *Planning Journal*, provides and excellent explanation of the Conservation Subdivision concept.

8. The Town of Mason should consider requiring on-site community water supply and waste water treatment systems for larger subdivisions and in areas of greater density.

The likelihood of Mason requiring a centralized public water supply system due to development density is low, and the cost of serving widespread, sparsely populated areas with centralized water is very high. Large-scale residential or commercial developments should be encouraged to develop self-contained, on-site community water supply and waste water treatment systems. This can allow for locally greater densities and support smart growth objectives such as open space development, which in turn can ultimately retain a larger percentage of the town's land area in natural vegetation and terrain – protecting the natural hydrology.

Centralized water supply systems for higher density areas or other types of development clusters may rely on one medium-yield, or even several low-yield wells, which could exploit smaller stratified drift deposits or even be located in bedrock by trial-and-error drilling. Protecting groundwater resources while setting up community systems should be a concern.

9. The Town of Mason should determine where the most probable high-yield well locations are in Town for possible use in the future.

The possibility of the need arising to supply small or large areas of town following contamination of ground water by accidental release of contaminants (in a catastrophic spill or the cumulative effect of small or systematic release) is always present, particularly in highway corridors and areas with manufacturing land uses.

The possibility of developing one or more high-yield bedrock wells is uncertain. Information on the favorability for well development is not readily available today. The NH Department of Environmental Services and US Geologic Survey have developed a coarse resolution analytical method for assessing bedrock formations' probability of supporting high-yield wells. That methodology could be applied to Mason to support preliminary discussion of the feasibility of further prospecting.

The Town can consult with NH DES Hydrologists and NH Geologic Survey to explore the bedrock aquifer favorability analysis.

10. The Town of Mason should take steps to protect surface water resources including wetlands through development of a comprehensive wetlands protection ordinance.

The dispersed development patterns of Mason, and the current zoning which will likely perpetuate low density residential development, might best be served by measures that safeguard the quality and availability of water town-wide. The use of programs and standards that can assure "good environmental hygiene" – clean air, clean soil and clean water – can avoid the need for centralized water supply by avoiding the contamination of surface and groundwater.

The town can initiate or otherwise promote a related set of measures to address surface water protection. Surface water quality is a function of both surface and subsurface conditions, since base stream flow, (between rain storms and snow melt periods) is supplied by ground water.

The Town is currently working to update its Wetlands Ordinance. Once this updated ordinance is adopted, there will be far greater protection of surface water and wetlands town-wide.

Review of Local Ordinances and Regulations (Jan. 2007)								
	Erosion and Sedimentation	Surface Water Flows	Groundwater Recharge	Mgmt of Existing & Potential Contaminant Sources	Flood Storage	Encroachment on Wetlands	Nutrient Levels	Wildlife & Fisheries Habitat
Planning (Zoning) Ordinance	2	1	1	1	3	2	1	1
Subdivision Regulations	2	2	2	1	2	2	2	1
Site Plan Review Regulations	2						2	
Building Codes	1	1	1	1	1	1	1	1
Rating: 1 – Not addressed in Local Regulation 2 – Included in Local Regulations – Revisions advisable 3 – Included in Local Regulations – Adequate provisions provided								

Protecting Groundwater Resources

By Pierce Rigrod

Many states and leading experts continue to stress the importance of containing and managing hazardous materials as a necessary strategy to maintain water quality. Managing hazardous materials to avoid releases to New Hampshire's water continues to be an important goal to ensure high-quality water resources. Releases of hazardous materials, such as gas, oil or solvents, often occur when stormwater washes them from commercial or industrial activities and into surrounding water resources. Treating stormwater containing more contaminants has a cost, and even as stormwater technology and designs improve, the additional cost and complexity of those systems underscores the need to have in place simple controls and management systems for potential ground or surface water contaminants.

The New Hampshire Department of Environmental Services' (DES) approach to protecting groundwater is a hierarchical approach that includes land conservation for the most sensitive resource areas, prohibiting a few "high-risk" land use restrictions and then applying proper management of hazardous substances.

Hazardous substances can be properly used in a manner that minimizes the risk of a spill or other release to groundwater or nearby surface water. Accordingly, the focus of groundwater protection programs should be on management of existing activities as well as effective performance standards for those new developments that utilize regulated substances. The need for local management to ensure proper use is apparent as many commercial and industrial areas "build out" in New Hampshire. Many of these industrial and commercial areas are located over the most productive stratified drift aquifers.

Better Management Through Best Management Practices (BMPs)

As directed by the New Hampshire legislature under the Groundwater Protection Act (RSA 485-C) the DES has established "best management practices" (BMPs) that must be employed by potential contamination sources (PCSs, defined under RSA 485-C) throughout the state. However, the reality is that local entities (municipalities and public water suppliers) are indispensable partners with DES in ensuring compliance with the BMP requirements. DES's Best Management Practices rule, (Env-Ws 421) applies to a defined set of "regulated substances" that pose a higher risk to groundwater quality. The BMPs are basic practices, which include the use of appropriate containers, labeling on containers, impervious floor surfaces and outdoor storage. For example, the BMP rule establishes that containers with regulated substances stored outside must be covered and placed upon impervious surfaces.

The BMP rule applies to *any* non-residential activity that uses more than household quantities (more than five gallons) of regulated substances, with few exceptions. Determining whether an activity or operation is following the state BMPs is not difficult or time consuming. Many water suppliers and local health officers visit these facilities to ensure BMPs are being used.

DES inspects underground storage tanks (USTs), above ground storage tanks (ASTs), hazardous waste generators, and solid waste facilities (to name several) to ensure that similar BMPs are employed at these facilities. However, many activities that use regulated substances do not require a state permit or registration, and could benefit from local review and oversight.

GROUNDWATER *from page 17*

For example, recent DES experiences with some auto salvage yards suggest that there is still more work to be done to both raise awareness and implement basic controls on storage, handling and use of gasoline, used oil, antifreeze and other potential contaminants that can be released into the surface or groundwater.

Examples of BMPs

Storage	Handling
• Store regulated substances on an impervious surface	• Place drip pans under spigots, valves and pumps
• Cover regulated containers in outside storage areas	• Have spill control and containment equipment readily available
• Keep regulated containers at least 50 feet from storm drains, if no secondary containment	• Perform transfers (for example, filling containers) over impervious surface

What Is a Local Groundwater Management Program?

Local groundwater protection can take a variety of forms, from having the Girl Scouts stenciling storm drains that discharge urban runoff or the Public Works instituting a low-salt policy near a community well. Usually, a groundwater management program is an organized approach to protecting an important groundwater resource area by providing regular public education activities and conducting on-site inspections to ensure compliance with the BMPs in the Env-Ws 421 rule or similar protections. Public education is targeted to residents and PCSs, and is typically distributed on an annual or a triennial basis. Towns or water suppliers are using creative strategies that maximize their educational messages, often publishing through multiple media outlets (that is, Web site, cable access TV, tax bills or town reports). Stratham, for example, puts information on managing potential contaminants within their town report, which is mailed to all residents of the town.

Where PCSs exist, a groundwater protection management program must address how BMPs are used within the context of specific industrial or commercial activities. This is done through BMP inspections, also referred to as BMP "surveys" of existing PCS activities and they are typically completed once every three years. Most local BMP inspection programs are conducted on a voluntary basis, meaning the PCS owners are not required to participate because the local entity has no regulatory authority. Where local entities acquire regulatory authority, either through local health regulations or through the groundwater reclassification process (see below), compliance with BMPs can be locally enforced. In New Hampshire approximately 73 public water systems conduct voluntary BMP surveys, mostly without enforcement authority.

Above: Poor control of regulated fluids at an auto salvage yard, 2005. Photo courtesy New Hampshire Department of Environmental Services.

A local groundwater management program may involve enforcement of state BMPs under RSA 485-C or RSA 147. A municipal health officer, under RSA 147, has the authority to enter onto private property to inspect and order removal of a nuisance that is "injurious" to the public's health. RSA 485-C:16 also gives concurrent authority (with DES) to health agents to issue cease and desist orders, when deemed necessary to protect groundwater. For example, enforcement to remove an open drum of oil or gas that is leaking and presents a public health nuisance can be conducted under the authority provided under RSA 147:4. But in circumstances where BMP rules are not being followed and there is no immediate nuisance or public health injury, a health officer must rely upon a local health ordinance or state groundwater reclassification for the authority to enforce state BMPs.

A Local Health Ordinance as a Groundwater Management Program

A town may adopt a local health ordinance to require local compliance with Env-421 BMPs, and establish a health agent's authority to enforce BMPs. Such a health ordinance should also spell out the local process regarding, PCS notification and BMP survey procedures, and local certification of compliance. Adopting a local health ordinance will be useful to ensure a BMP program is properly administered and consistent with other local ordinances. Several steps should be taken in advance when planning the adoption of a health ordinance, including: 1) delineating the groundwater resource area, (that is, wellhead protection areas or aquifer); 2) identifying PCSs within that area that will be surveyed; and 3) establishing a survey protocol for use by the health agent. By adopting a local health ordinance, the municipality may specifically define the set of activities or land use activities that it determines to be PCSs, beyond what is considered a PCS as listed under RSA 485C. DES provides a model health ordinance for communities interested in adopting a local health ordinance, however, consult with town counsel and DES in advance of adoption. (DES's Model Health Ordinance can be found at www.des.nh.gov/dwspp/hodoc4.pdf.)

State Reclassification as a Groundwater Management Program

The legislature also allows a local entity (town or water supplier) to make application to DES to "reclassify" a specific area around a public water supply well, an aquifer or other area that contains locally important groundwater resources as determined by the local entity. Reclassification of wellhead protection areas (WHPAs) or other areas of high-value groundwater (that is, highly productive aquifers), also involves instituting a local PCS education and survey program as a means to greater adherence to BMPs.

Reclassification of wellhead protection areas (referred to as GAA in RSA 485-C) also prohibits the development of new solid waste landfill or hazardous waste disposal facility, outdoor storage of deicing chemicals (including salt), auto salvage yards, snow dumps or wastewater or septage lagoons within the wellhead protection area of a public water supply.

Reclassification through RSA 485-C:15 also gives the authority to local health agents to enter onto private property to enforce provisions under the statute, including the state BMPs. DES's Model Health Ordinance provides an approach with draft language for adopting a local health ordinance in conjunction with or independently from state groundwater reclassification.

New Development and Groundwater Protection Zoning Ordinances

The focus of a groundwater protection program should not only be on what currently is "on the ground" but also what activities are coming in the future. At least sixty-two municipalities have land use restrictions to protect groundwater resources. The state Model Groundwater Protection Ordinance combines a few land use restrictions with required performance standards that are based upon the requirements of Env-Ws 421 BMPs. Groundwater protection zoning or rules can establish performance standards that improve stormwater quality and require spill control plans that reduce the release of regulated substances to groundwater. Beyond zoning, site plan review rules can be drafted to improve the control of regulated substances and limit the commingling of contaminated surfaces with clean stormwater through the design and management of loading pads, fuel transfer areas, outdoor storage or waste areas. Good site design can offset poor management by having structural protection built around or within the operations or activities that take place upon the site.

RSA 674 permits local governments to adopt innovative land use controls that include environmental characteristics zoning (that is, wetlands, groundwater, etc.) and performance standards. For example, if there is a violation of a local performance standard that protects groundwater (for example, improper storage of wastes) local governments may issue cease and desist orders (RSA 676:17-a) and local land use citations (RSA 676:17-b), or may pursue civil penalties and injunctive relief in superior or district court (RSA 676:15, 17). Again, when considering the adoption of a groundwater protection ordinance or enforcement, consult your local town counsel.

DES can provide BMP survey training, sample forms and letters, model zoning language, maps and information as well as references to existing local groundwater protection programs.

Pierce Rigrod is a Principal Planner with DES's Source Water Protection Program and provides technical assistance to municipal officials and water suppliers on protecting drinking water supplies in New Hampshire. He can be contacted by e-mail at prigrod@des.state.nh.us or by phone at 603.271.0688.

Inventory of Public Water Supply Sources and Potential and Existing Sources of Groundwater Contamination in MASON, NH

Notes:
1. Report prepared December 7, 2006 by the NHDES Water Supply Engineering Bureau.
2. The map-cell column in the report indicates which 1000-foot grid cell the site or facility is located on the accompanying map. For example, a map-cell value of "G-11" indicates column "G" and row "11".
3. Only those sites or facilities that are within a 4000-foot buffer of the map's named city or town are listed in this report.

Source Water Hazard Inventory Sites

This includes all Groundwater Hazard Inventory, Remediation Sites, and Initial Response Spill Sites regulated by NHDES to ensure water resource protection. For a description of particular project types, please see the attached key.

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	PROJECT TYPE
X-15	199612016	MASON QUARRY STARCH MILL ROAD MASON TAX MAP: B, LOT: 17	LAST (INACTIVE) Risk: 8
X-15	199612016	MASON QUARRY STARCH MILL ROAD MASON TAX MAP: B, LOT: 17	UIC Risk: 8 Staff: REGISTRATION
I-17	200406128	CONCRETE PRODUCTS INC. 87 ADAMS HILL RD GREENVILLE	SPILL/RLS (INACTIVE) Risk: 8
I-19/ I-20	199103026	GREENVILLE ABANDONED DUMP OFF OLD MASON ROAD GREENVILLE TAX MAP: 2, LOT: 44	OLD DUMP Risk: NDY Staff: UNASSIGNED
I-23	200302057	PATRICA PIPER 602 FITCHBURG ROAD, LOT 26 GREENVILLE	OPUF (INACTIVE) Risk: 8
I-23	199706037	STEVEN DONALDSON 602 FITCHBURG ROAD LOT 20 GREENVILLE TAX MAP: 00F, LOT: 20	OPUF (INACTIVE) Risk: 8
Y-23	200102011	KEN ENGLISH 773 BROOKLINE RD MASON	OPUF (INACTIVE) Risk: 8
K-29	199306002	ROBERT BELANGER 51 GREENVILLE ESTATES PARK GREENVILLE	SPILL/RLS (INACTIVE) Risk: 8
K-32	200108003	TWEEDY TRANSPORT 49 FITCHBURG ROAD MASON	UIC Risk: 1 Staff: REGISTRATION
K-34	200203054	WEE DREAMS LEARNING CENTER 712 TURNPIKE RD NEW IPSWICH	ETHER (INACTIVE) Risk: 8
K-35	200204044	WILLIAM FALGARES 93 TURNPIKE RD MASON	OPUF (INACTIVE) Risk: 8

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	PROJECT TYPE
K-35	198906043	STATELINE VARIETY 403 FITCHBURG RD MASON TAX MAP: J, LOT: 20	LUST Risk: 5 Staff: WHIPPLE
J-36	198903002	RUGGIERO PIG FARM CHURCHILL ROAD MASON TAX MAP: J, LOT: 69	HAZWASTE (INACTIVE) Risk: 8

Aboveground Storage Tank Facilities

These are facilities where there are, or where in the case of inactive sites, aboveground storage tanks. If there is a documented release from a tank, it becomes a LAST project type and is listed in the Source Water Hazard Inventory.

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	# TANKS
		<< NO FACILITIES PRESENT >>	

Underground Storage Tank Facilities

These are facilities where there are, or where in the case of inactive sites, underground storage tanks. If there is a documented release from a tank, it becomes a LUST project type and is listed in the Source Water Hazard Inventory.

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	# TANKS
X-15	0111086	MASON QUARRY STARCH MILL ROAD MASON TAX MAP: B, LOT: 17	TANKS: 0 (INACTIVE)
R-29	0112150	TOWN OF MASON 101 DEPOT RD MASON TAX MAP: G, LOT: 73	TANKS: 0 (INACTIVE)
R-29	0114049	MASON HIGHWAY DEPT 83 DEPOT RD MASON	TANKS: 1
K-35	0113717	STATELINE VARIETY ROUTE 31 & 124 MASON TAX MAP: J, LOT: 20	TANKS: 0 (INACTIVE)

Automobile Salvage Yards

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	STATUS
		<< NO FACILITIES PRESENT >>	

Local Potential Contamination Source Inventory Sites

Includes potential contamination sources within a source water protection area. The sites were located by Public Water Systems applying for a sampling waiver, or by NHDES-WSEB staff during “windshield surveys”.

MAP CELL	SITE#	SITE NAME AND ADDRESS	PROJECT TYPE
M-32	15150301A	<UNNAMED SITE> MASON	WSPS
K-35	15150301B	JT's Power Equipment Route 124 MASON	GSR

National Pollutant Discharge Elimination System (NPDES) Outfalls

All facilities which discharge any pollutant from point sources to surface waters (directly or indirectly) are required to obtain a federal permit from the US Environmental Protection Agency and a State Water Discharge Permit from NHDES.

MAP CELL	OUTFALL ID#	FACILITY NAME AND ADDRESS	STATUS TYPE CATEGORY WATER BODY
Y-13	0020524	FLETCHER GRANITE COMPANY, INC. STARCH MILL ROAD MASON	INACTIVE MINOR WW SPAULDING BROOK VIA TRIB.

Point/Non-point Potential Pollution Sources

These include local land-use inventories performed by the Regional Planning Commission in 1995. For a description of the Project Types, see the attached key.

MAP CELL	SITE#	SITE NAME AND ADDRESS	PROJECT TYPE
AI-15	195-07	BURBEE GRAVEL PIT MILE SLIP ROAD MILFORD	MS

Resource Conservation & Recovery Act (RCRA) Sites

These are facilities that generate hazardous waste. If a release is documented, it listed under the Source Water Hazard Inventory Sites.

MAP CELL	FACILITY SITE#	FACILITY NAME AND ADDRESS	STATUS REGULATED GEN. TYPE
AG-04	NHD500014436	CONSOLIDATED RECYCLING INC 164 MILE SLIP RD MILFORD	DECLASSIFIED RCRA REGULATED NONE
G-07	NHD066750480	KIMBALL PHYSICS 311 KIMBALL HILL RD WILTON	ACTIVE RCRA REGULATED SQG(CESQG)
X-15	NHD510101272	FLETCHER GRANITE CO 589 STARCH MILL RD MASON	ACTIVE STATE REGULATED NONE
I-22	NHD048725816	FROST FARM SERVICE INC 53 MASON RD GREENVILLE	ACTIVE STATE REGULATED NONE

Registered Water Users

"Use of water" includes the withdrawal of water from the ground or surface water body, the delivery of water from another supplier to the user indicated, the release of water from the user indicated to another facility, and/or the return of water to the environment.

MAP CELL	SDID	FACILITY NAME AND ADDRESS	ACTION TYPE WATER BODY
Y-13	20405-D01	MASON QUARRY STARCH MILL ROAD MASON	RETURN (INACTIVE) INDUSTRIAL OLD QUARRY POND
Z-13	20405-S01	MASON QUARRY STARCH MILL ROAD MASON	WITHDRAWAL (INACTIVE) INDUSTRIAL OLD QUARRY POND
K-29	20700-S01	GREENVILLE ESTATES 41 OLD ASHBY ROAD GREENVILLE	WITHDRAWAL WATER SUPPLIER BEDROCK WELLFIELD

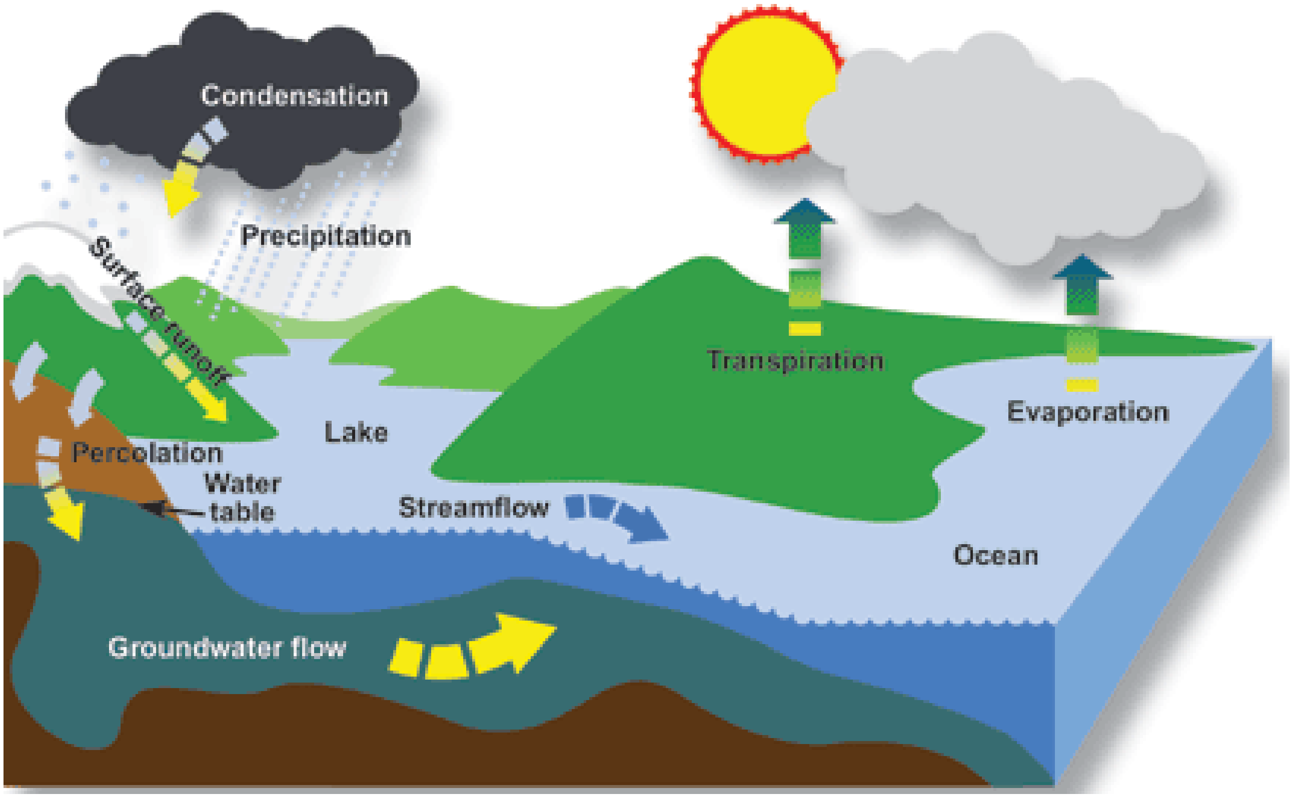
PUBLIC DRINKING WATER SUPPLIES - MASON, NH

Notes:
1. Report prepared December 7, 2006 by the NHDES Water Supply Engineering Bureau.
2. Public Water Supply Sources are labeled on the map with their respective PWS ID numbers. The map-cell values (shown in parenthesis beneath the PWSID in the report) indicates which 1000-foot grid cell the source is located on the accompanying map. For example, a map-cell value of "G-11" indicates column "G" and row "11".
3. Only those sources that are within a 4000-foot buffer of the map's named city or town are listed in this report.

PWSID	SYSTEM NAME AND ADDRESS	SYS. TYPE	SYS. ACTIVE	SRC. TYPE	SRC. ACTIVE	SRC. REC.	WELL TYPE	WELL DEPTH	POP. SERVED
2522010-001 (U-05)	ORCHARD VIEW ORCHARD VIEW DR WILTON	C	I	G	A	SG	BRW	345	15
1518010-001 (L-12)	PICKITY PLACE NUTTING HILL RD, PO BOX 544 MASON	N	A	G	A	SG	BRW	100	60
1518010-501 (L-12)	PICKITY PLACE NUTTING HILL RD, PO BOX 544 MASON	N	A	E	A	PT		0	60
1518010-002 (L-12)	PICKITY PLACE NUTTING HILL RD, PO BOX 544 MASON	N	A	G	A	SG	BRW	0	60
0993030-001 (I-23)	FROST TRAILER PARK RTE 31 GREENVILLE	C	A	G	A	SG	BRW	181	73
0993030-002 (I-23)	FROST TRAILER PARK RTE 31 GREENVILLE	C	A	G	A	SG	BRW	275	73
0993030-501 (I-23)	FROST TRAILER PARK RTE 31 GREENVILLE	C	A	E	A	PT		0	73
0999010-001 (K-25)	MERRIAM HILL CENTER 148 MERRIAM HILL RD, RTE 123 GREENVILLE	N	I	G	A	SG	BRW	180	25
1515010-001 (P-25)	MASON PUBLIC SCHOOL RTE 123 MASON	P	A	G	A	SG	BRW	290	111
1515010-501 (P-25)	MASON PUBLIC SCHOOL RTE 123 MASON	P	A	E	A	PT		0	111
1519010-001 (P-26)	MASON CONGREGATIONAL CHURCH VALLEY ROAD MASON	N	I	G	A	SG		0	15

PWSID	SYSTEM NAME AND ADDRESS	SYS. TYPE	SYS. ACTIVE	SRC. TYPE	SRC. ACTIVE	SRC. REC.	WELL TYPE	WELL DEPTH	POP. SERVED
1518020-001 (AC-26)	PARKERS MAPLE BARN/SUGAR HOUSE 1349 BROOKLINE RD MASON	N	A	G	A	SG	BRW	1230	300
1518020-002 (AC-26)	PARKERS MAPLE BARN/SUGAR HOUSE 1349 BROOKLINE RD MASON	N	A	G	A	SG	BRW	1250	300
1518020-501 (AC-26)	PARKERS MAPLE BARN/SUGAR HOUSE 1349 BROOKLINE RD MASON	N	A	E	A	PT		0	300
0993020-001 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	G	I	SG	BRW	380	480
0993020-002 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	G	I	SG	BRW	126	480
0993020-003 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	G	A	SG	BRW	150	480
0993020-004 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	G	I	SG	BRW	430	480
0993020-005 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	E	A	PT		0	480
0993020-503 (J-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	E	A	PT		0	480
0993020-006 (K-29)	GREENVILLE EST TENANTS COOP RTE 31 GREENVILLE	C	A	G	A	SG	BRW	600	480
1712020-001 (B-34)	THE COLONIAL APARTMENTS MASON RD NEW IPSWICH	C	I	G	A	SG	BRW	365	25
1515030-001 (K-34)	IMAGINE THAT EARLY LRNING CTR 339 FITCHBURG RD, RTE 31 MASON	P	A	G	A	SG	BRW	0	40
1515030-501 (K-35)	IMAGINE THAT EARLY LRNING CTR 339 FITCHBURG RD, RTE 31 MASON	P	A	E	A	PT		0	40

Figure 1



Evaporation: As water is heated by the sun, its surface molecules become sufficiently energized to break free of the attractive force binding them together, and then *evaporate* and rise as invisible vapor in the atmosphere.

Transpiration: Water vapor is also emitted from plant leaves by a process called transpiration. Every day an actively growing plant *transpires* 5 to 10 times as much water as it can hold at once.

Condensation: As water vapor rises, it cools and eventually *condenses*, usually on tiny particles of dust in the air. When it condenses it becomes a liquid again or turns directly into a solid (ice, hail or snow). These water particles then collect and form clouds.

Precipitation: Precipitation in the form of rain, snow and hail comes from clouds. Clouds move around the world, propelled by air currents. For instance, when they rise over mountain ranges, they cool, becoming so saturated with water that water begins to fall as rain, snow or hail, depending on the temperature of the surrounding air.

Runoff: Excessive rain or snowmelt can produce overland flow to creeks and ditches. Runoff is visible flow of water in rivers, creeks and lakes as the water stored in the basin drains out.

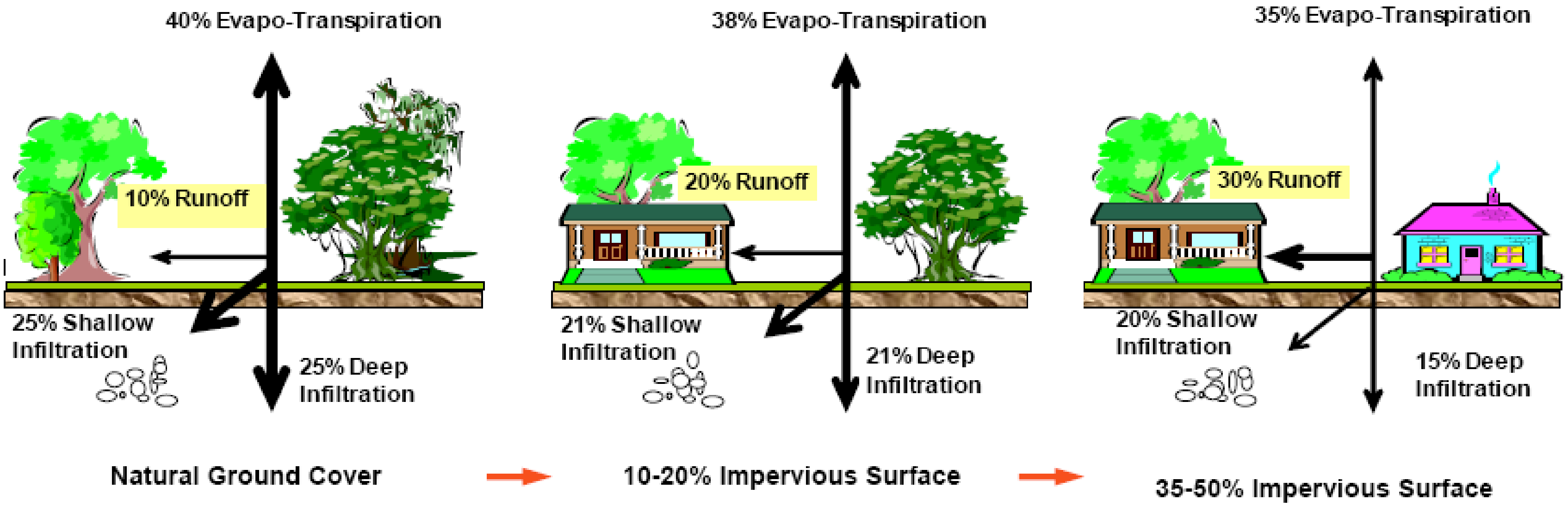
Percolation: Some of the precipitation and snow melt moves downwards, *percolates* or *infiltrates* through cracks, joints and pores in soil and rocks until it reaches the water table where it becomes groundwater.

Groundwater: Subterranean water is held in cracks and pore spaces. Depending on the geology, the groundwater can flow to support streams. It can also be tapped by wells. Some groundwater is very old and may have been there for thousands of years.

Water table: The water table is the level at which water stands in a shallow well.

http://www.ec.gc.ca/WATER/en/nature/grdwtr/e_cycle.htm

Figure 2



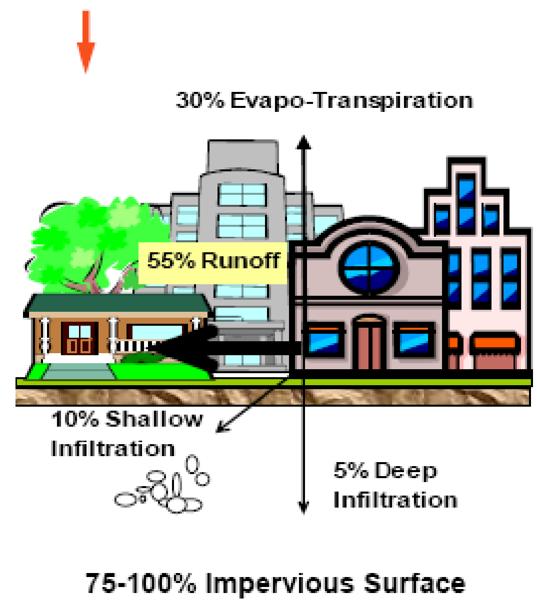


Figure 2. How impervious cover affects the water cycle.

With natural groundcover, 25% of rain infiltrates into the aquifer and only 10% ends up as runoff. As imperviousness increases, less water infiltrates and more and more runs off. In highly urbanized areas, over one-half of all rain becomes surface runoff, and deep infiltration is only a fraction of what it was naturally [6].

The increased surface runoff requires more infrastructure to minimize flooding. Natural waterways end up being used as drainage channels, and are frequently lined with rocks or concrete to move water more quickly and prevent erosion.

In addition, as deep infiltration decreases, the water table drops, reducing groundwater for wetlands, riparian vegetation, wells, and other uses.